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Impact of 24-hour Postural Care in Management of Scoliosis, Windswept Deformity, Hip Dislocation, and Subluxation in Children with Cerebral Palsy: A Literature Review

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Abstract

Cerebral Palsy (CP) describes various challenges with movement and coordination caused by early brain damage which does not progress with age. CP is a lifelong condition and is usually associated with secondary complications across the lifespan. This review aims to explore the impact of twenty-four-hour postural care in prevention and management of secondary complications such as scoliosis, windswept deformity and hip dislocation or subluxation in children with cerebral palsy. The studies published between 2014 and 2025, in English language in databases PubMed and Google Scholar were included. 19 studies were reviewed which indicated use of postural care and control in preventing subsequent issues such as hip dislocation, contractures, windswept deformities, and scoliosis. Supported standing, weight-bearing exercises, and neurodevelopmental treatment were among the interventions that have been shown to increase comfort, involvement, and caring ease. Postural management has been shown to improve alignment, decrease hip migration, and thereby increase functional independence. While proactive and early postural control is encouraging overall, more research is needed to determine how best to use it and what will be its long-term effects. There seems to be a lacunae of information regarding use of 24 hour postural care in preventing complications in children with CP, what protocol to follow and addressing the most vulnerable CP children with severe motor deficits. A key component of long-term postural care will also be incorporating caregiver education and adjustments to everyday routines. All measures and ways which can help to prevent or prolong the incidence of secondary complications in individuals with CP are supposed to have a positive impact on the life of individuals and their family.

Keywords: Cerebral Palsy, Scoliosis, Windswept deformities, Hip dislocation/subluxation, caregiver education, posture correction, 24 hour postural management

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Introduction

Cerebral palsy (CP) is the most prevalent motor disability in childhood, affecting approximately 2–3/1000 live births worldwide.[1-3] Among children with CP, particularly those classified under Gross Motor Function Classification System (GMFCS) levels IV and V, the risk of developing secondary musculoskeletal deformities such as scoliosis, windswept deformity, hip dislocation, and subluxation is markedly elevated.[2-5] These deformities compromise posture, function, and comfort and are associated with increased pain, reduced participation, and caregiver burden.[6-9]

Scoliosis, defined as a lateral curvature of the spine, affects up to 75% of non-ambulant children with CP by adolescence.[10] Windswept deformity, characterized by asymmetric abduction and adduction of the hips, often results from prolonged asymmetrical lying postures and contributes to pelvic obliquity and hip instability.[11-13] Hip dislocation and subluxation are particularly concerning in children with limited mobility, with migration percentages exceeding 30% in many cases by age five.[14,15] These conditions are progressive and, if not addressed early, may necessitate surgical intervention.[16]

The concept of 24-h postural care has emerged as a proactive, non-invasive strategy to mitigate these risks.[17] It involves the intentional use of positioning systems across all daily contexts lying, sitting, and standing to promote symmetrical alignment, reduce pressure points, and prevent the development or progression of deformities.[18] Unlike isolated therapy sessions, 24-h postural care integrates therapeutic principles into the child's entire daily routine, emphasizing consistency and continuity.[19]

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Evidence supports the role of early and individualized postural management in improving musculoskeletal outcomes. Studies have shown that consistent use of seating and standing systems can reduce hip migration, improve pelvic alignment, and slow the progression of scoliosis.[20] In addition, interventions such as sleep positioning systems, stabilizing pressure input orthosis (SPIO) vests, and therapist-guided routines have demonstrated improvements in trunk posture and sitting balance.[21]

Despite its clinical relevance, the implementation of 24-h postural care remains inconsistent across settings, often hindered by limited awareness, training, and access to appropriate equipment. This narrative review aims to synthesize current evidence on the impact of 24-h postural care in managing scoliosis, windswept deformity, hip dislocation, and subluxation in children with CP. By highlighting key findings, mechanisms of action, and

clinical implications, this review seeks to inform best practices and promote early, therapist-guided intervention strategies.

Methodology

This narrative review synthesizes evidence published between 2014 and 2024 on the impact of 24-h postural care in managing scoliosis, windswept deformity, hip dislocation, and subluxation in children with CP. A structured literature search was conducted across PubMed, CINAHL, and the Cochrane Library using Boolean operators and relevant keywords. The search terms included ("Cerebral palsy" OR "CP") AND ("postural care" OR "positioning" OR "seating system" OR "sleep system" OR "standing frame") AND ("scoliosis" OR "windswept deformity" OR "hip dislocation" OR "hip subluxation") NOT ("animal studies") NOT ("non-English").

Studies were included if they (1) involved pediatric populations with CP; (2) evaluated postural care interventions in lying, sitting, or standing contexts; and (3) reported outcomes related to musculoskeletal alignment, deformity progression, or hip migration. Only peer-reviewed articles published in English were considered.

Exclusion criteria comprised studies focusing solely on surgical or pharmacological interventions, adult populations, or those lacking specific outcomes relevant to postural care. Titles and abstracts were screened for relevance, followed by full-text review of eligible studies. Key data were extracted on study design, sample characteristics, intervention type, and musculoskeletal outcomes. The flow of research methodology is depicted in Figure 1.

Result

Nineteen studies met the inclusion criteria and were retained for final synthesis. These studies predominantly focused on early, therapist-guided physiotherapy interventions in infants at risk for CP, emphasizing movement quality, family-centered approaches, and neurodevelopmental principles. Intervention characteristics, sample sizes, and outcome measures are detailed in Table 1.

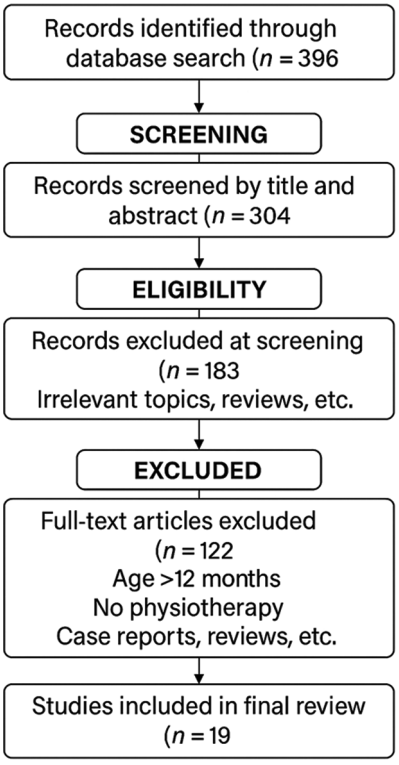

Figure 1: Flow of research methodology

Discussion

This review underscores the pivotal role of 24-h postural care in mitigating musculoskeletal complications – particularly scoliosis, windswept deformity, hip dislocation, and subluxation – in children with CP. Across the included studies, consistent themes emerged: Early intervention, individualized positioning strategies, and therapist-guided implementation are essential to prevent deformity progression and enhance functional outcomes.

Scoliosis and Windswept Deformity

Scoliosis is highly prevalent in non-ambulant children with CP, with progression often beginning before adolescence. Korkmaz *et al*. (2022) demonstrated that customized seating systems significantly reduced curve progression and improved spinal alignment in children with GMFCS levels IV and V. Similarly, Sahinoğlu *et al*. (2016) found that modular seating equipment improved trunk stability and upper limb function, suggesting that enhanced postural control may indirectly reduce compensatory spinal curvature.

Windswept deformity, often linked to prolonged asymmetrical lying postures, contributes to pelvic obliquity and hip instability. Casey *et al*. (2022), in a large observational study of 2450 children, identified strong associations between windswept hips, scoliosis, and pain in both supine and sitting positions. Their findings reinforce the importance of symmetrical positioning during rest and daily activities. Educational interventions, such as those described by Hotham *et al*. (2017), have shown that caregiver training improves confidence and consistency in implementing postural routines, which may help prevent windswept patterns from becoming fixed.

Hip Dislocation and Subluxation

Hip displacement is a major concern in children with limited mobility. Paleg and Livingstone (2022) emphasized the importance of early, evidence-informed postural management to preserve hip integrity and reduce the risk of dislocation. Meyling *et al*. (2018), in a systematic review, concluded that consistent use of seating and standing systems reduced hip migration and improved pelvic alignment. Faccioli *et al*. (2024) provided preliminary randomized controlled trial (RCT) data showing that sitting postural management slowed the progression of migration percentage in children with GMFCS level V.

Orthotic interventions also play a role. Giray *et al*. (2018) found that SPIO vests improved trunk control and reduced hip lateralization, supporting their use in maintaining midline posture. Hippotherapy, as explored by Moraes and Rocha (2016, 2018), was associated with enhanced pelvic symmetry and sitting balance, suggesting that dynamic postural challenges may complement static positioning strategies.

Mechanisms and Therapeutic Principles

The therapeutic impact of 24-h postural care lies in its ability to redistribute pressure, promote symmetrical alignment, and

Table 1: Summary of included studies

S. No.	Author (year)	Sample size/ design	Intervention type	GMFCS level	Musculoskeletal focus	Key findings
1.	Paleg and Livingstone (2022)	Narrative review	24-h postural care across lying, sitting, and standing	IV-V	Hip dislocation, subluxation	Emphasized early, evidence-informed postural management to preserve hip integrity and reduce risk of dislocation
2.	Meyling *et al*. (2018)	Systematic review	Seating, standing, lying systems	I-V	Hip migration	Consistent postural care reduced hip migration; highlighted need for individualized strategies
3.	Casey *et al*. (2022)	2450 children; observational	Supine and sitting asymmetry assessment	All levels	Scoliosis, windswept hips, contractures	Strong association between asymmetrical postures and pain; windswept deformity linked to scoliosis progression
4.	Faccioli *et al*. (2024)	RCT (preliminary data)	Sitting postural management	IV-V	Hip migration	Sitting systems slowed the progression of migration percentage; early intervention critical
5.	Korkmaz *et al*. (2022)	RCT	Custom seating system for scoliosis	IV-V	Scoliosis	Significant reduction in curve progression; improved spinal alignment and sitting tolerance
6.	Giray *et al*. (2018)	RCT	SPIO vest (lycra-based orthosis)	III-V	Trunk posture, hip lateralization	Improved trunk control and reduced hip lateralization; effective in maintaining midline posture
7.	Moraes and Rocha (2016, 2018)	Longitudinal study	Hippotherapy	II-IV	Sitting balance, pelvic alignment	Enhanced postural balance in sitting; improved functional ability and pelvic symmetry over time
8.	Holmes *et al*. (2018)	Scoping review	Postural asymmetry in adults with CP	IV-V (adult)	Scoliosis, windswept deformity	Persistent asymmetries linked to long-term deformities; underscored need for early postural care
9.	El-Kafy and El-Shamy (2022)	RCT	Soft orthotic strapping	III-V	Kyphotic posture, spinal mobility	Improved thoracic alignment and spinal mobility; effective conservative strategy for postural correction
10.	Matusiak-Wieczorek *et al*. (2020)	Observational	Hippotherapy	II-IV	Sitting posture	Improved symmetry and postural control in sitting; beneficial adjunct to conventional therapy
11.	Sahinoğlu *et al*. (2016)	Comparative study	Seating equipment (modular vs. standard)	III-V	Postural control, upper limb function	Modular seating improved trunk stability and upper extremity function; reduced compensatory movements
12.	Karabicak *et al*. (2016)	Cross-sectional	Balance and postural control assessment	I-III	Femoral anteversion	Poor postural control correlated with increased femoral anteversion; highlighted biomechanical implications
13.	Hotham *et al*. (2017)	Educational intervention	Postural care training for caregivers	IV-V	General postural awareness	Increased caregiver confidence and understanding; improved implementation of postural routines
14.	Toohey *et al*. (2024)	Umbrella review	Multiple postural interventions	I-V	Scoliosis, hip migration, windswept	Synthesized evidence across modalities; confirmed effectiveness of integrated postural care strategies
15.	Kim and Yoo (2018)	RCT	Manual therapy+FES	III-IV	Scoliosis curve	Reduced scoliosis angle; combined approach enhanced spinal alignment
16.	Pasin Neto *et al*. (2017)	RCT	Postural insoles	I-III	Gait, pelvic alignment	Improved gait symmetry and pelvic control; indirect benefit on hip stability
17.	Montero Mendoza *et al*. (2015)	Correlational study	Sitting postural control assessment	I-IV	Gross motor function, sitting balance	Strong correlation between GMFCS level and postural control; emphasized need for tailored interventions
18.	Ali (2019)	Educational intervention	Core stability training	II-III	Postural control	Improved trunk stability and postural endurance; reduced compensatory patterns
19.	Tekin *et al*. (2018)	RCT	Neurodevelopmental treatment (Bobath)	II-IV	Balance, postural control	Enhanced postural symmetry and dynamic balance; therapist-guided progression essential

RCT: Randomized controlled trial, GMFCS: Gross motor function classification system, FES: Functional electrical stimulation

interrupt sustained abnormal postures. Paleg and Livingstone (2022) described how postural care integrates therapeutic principles into the child's entire daily routine, reinforcing neuromuscular control and biomechanical stability. Holmes *et al*. (2018), in a scoping review of adults with CP, highlighted the long-term consequences of unmanaged postural asymmetry, reinforcing the need for early intervention.

Therapist-guided approaches are essential for ensuring biomechanical accuracy and individualized progression. Tekin *et al*. (2018) demonstrated that neurodevelopmental treatment

(Bobath concept) improved postural symmetry and dynamic balance. Ali (2019) showed that core stability training enhanced trunk endurance and reduced compensatory patterns. Kim and Yoo (2018) reported that manual therapy combined with functional electrical stimulation reduced scoliosis curvature, suggesting that multimodal strategies may be particularly effective.

Clinical Implications

The evidence supports integrating 24-h postural care into routine rehabilitation for children with CP, especially those at higher GMFCS levels. Interventions should be tailored to the child's musculoskeletal profile and daily routines, with active involvement from caregivers and interdisciplinary teams. Despite its proven benefits, implementation remains inconsistent, often limited by resource constraints and lack of training. Hotham *et al*. (2017) emphasized that caregiver education is a key enabler of successful postural care.

This review's strength lies in its inclusion of diverse intervention modalities and study designs, offering a comprehensive perspective on postural care strategies. However, limitations include variability in outcome measures, heterogeneity in intervention protocols, and the predominance of short-term follow-up data. Future research should focus on long-term outcomes, cost-effectiveness, and strategies to embed postural care into broader neurorehabilitation frameworks.

Conclusion

24-h postural care plays a vital role in preventing and managing scoliosis, windswept deformity, hip dislocation, and subluxation in children with CP. Evidence supports early, individualized, and therapist-guided interventions across all daily positions to improve alignment and reduce deformity progression. Integrating these strategies into routine care can enhance comfort, function, and long-term musculoskeletal outcomes.

Strengths

This review offers a comprehensive synthesis of evidence spanning a decade (2014–2024), encompassing a variety of study designs including RCTs, systematic reviews, and observational studies. It integrates findings across multiple musculoskeletal domains – scoliosis, windswept deformity, hip dislocation, and subluxation – providing a unified and clinically relevant framework for pediatric neurorehabilitation. The inclusion of both static (e.g., seating and sleep systems) and dynamic (e.g., hippotherapy) interventions reflects the diversity of real-world therapeutic approaches. Furthermore, the emphasis on therapist-guided and individualized strategies enhances the practical applicability of the findings for clinicians working with children across GMFCS levels.

Limitations

Despite its breadth, the review is limited by the heterogeneity of included studies in terms of design, sample size, intervention protocols, and outcome measures, which restricts direct comparison and precludes meta-analysis. Most studies reported short-term outcomes, limiting insights into the long-term effectiveness and sustainability of postural care interventions. Variability in therapist involvement and adherence to intervention protocols may also influence the generalizability of results. In addition, the exclusion of non-English language publications may have introduced language bias and omitted potentially relevant international research.

Conflict of Interest

The authors declare no conflict of interest related to this study.

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